

The practical methodology of evolutionary analysis

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The role of methodology

- “Not the first, but the last chapter of a [scientific] system should deal with methodology.”
(Schumpeter, 1908, p. xi)
- Three aspects of methodology
 - Practical advice for individual studies
 - Explanation of the differences between disciplines
 - Basic principles of scientific practice

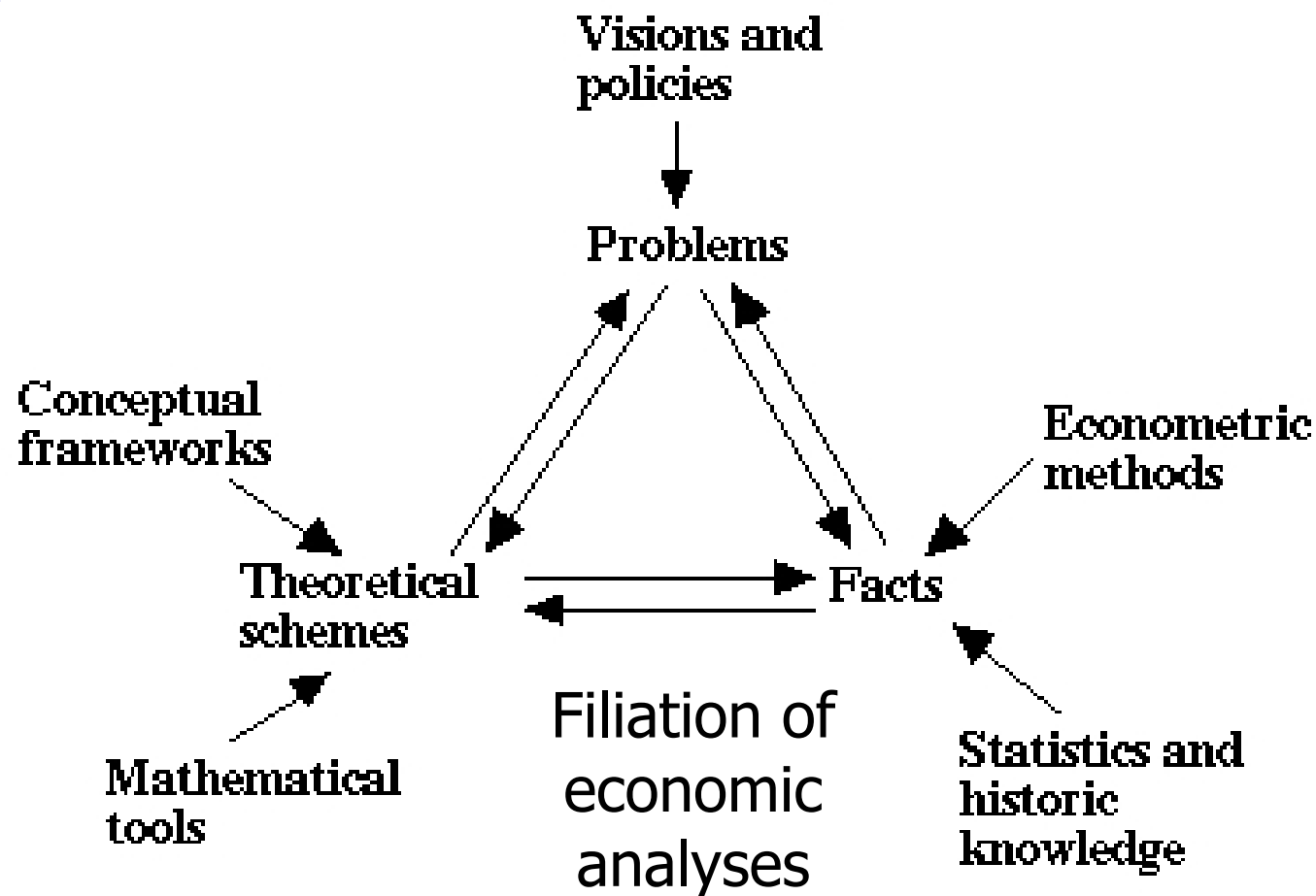


The role of history, statistics and theory

- “[I]n order to construct a scheme [model] that will describe the modus operandi of these changes [in production and consumption functions], it is necessary to refer to industrial history which, when the analytical work is done, will again provide verifications, checks, amplifications, qualifications, and also tell us where we might expect oscillatory movements to play a role. **Theoretical and statistical analysis is in this task as necessary as is historical work. In fact they are inseparable because there is an incessant give and take between them.**”

(Schumpeter, 1951, p. 315)

Schumpeter's idea of the development of economic science





How to build an economic model in your spare time (Varian, 1997)

- **Look for good ideas in real world**, not only in theoretical journals
- **Be aware of the basic structure** of economic models
 - Actors/agents that behave to advance their objectives within constraints
 - How do they interact?
 - What changes if the behaviour of agents is not consistent?
- **First make your model as simple as possible** (the KISS principle)— then make it more general and/or interesting
- **Don't look too much in the literature** before you have a fairly clearcut model yourself: don't import complexity from the models of other researchers
- **Design a clearcut and convincing seminar presentation**— starting from the well known
- **Write a paper** following the seminar outline
- **Stop** before things get too complex: don't overelaborate the model



How to build an evolutionary model in your spare time (additional requirements)

- **Understand evolution**

- Spend some time to think about the basic mechanisms of evolution: It takes time!
- Try to find out how a couple of evolutionary models are really functioning

- **Avoid the complexity crisis**


- Be aware that evolutionary models tend to be more complex than standard models
- Set up a clearcut task for the model, e.g. to explain a clearcut stylised fact; don't be too general
- Work backwards from the phenomenon you would like your model to produce; if the phenomenon cannot be reproduced, maybe you should look for a simpler phenomenon

- **Answer the basic questions:**

- What evolves? What accounts for the actor's inertia with respect to behavioural rules? What happens if the behaviour of an agent is ill-adapted? Bankruptcy or learning of new rules? How are new types of behaviour created?


- **Decide why you want an evolutionary model**

- As a thinking tool for empirically oriented studies—perhaps only the basic mechanisms
- As a tool for model building, computer simulation and mathematical analysis




How to build an simulation model in your spare time (additional requirements)

- **Build on an existing simple simulation model**
- **Make a demand specification** for your version
 - including theoretical considerations and stylised facts
- **Make a model design**
 - using verbal descriptions, flow charts, computer pseudo-code, ...
- **Develop the program step by step**
 - After each new line, check that the simulation program runs correctly!
- **Perform systematic simulation experiments**
- **Make statistical analysis** when you have a stable model
- **Make an extensive documentation of the simulation model**
- **Check** that the simulation program is doing what you think it does



Modelling and simulation in practice: Andersen's initial propositions

- 1. Empirical investigation and policy analysis in the area of technical and institutional change **need a theoretical framework**.
- 2. **New evolutionary economics** is an important candidate of a theoretical framework.
- 3. The most basic goal of the evolutionary approach is to **provide explanations** of recurrent economic and technological phenomena. The standard title of articles are "The Evolution of X" (where X is money, commodity characteristics, software standards, ...).
- 4. Evolutionary explanations demonstrate that the socio-economic phenomenon is the result of **a historical process which involves** storing and transmission of "routines", creation of new "routines", selection between "routines" - and the segregation between "populations" involved in different evolutionary processes.
- 5. Even simple evolutionary processes are **surprisingly complex** and can normally only be grasped by construction and simulation of explicit models.
- 6. Through the analysis of such models it becomes obvious that often the explained phenomenon is **only locally adapted/optimal and that we do not have a totally general evolutionary mechanism** (contrary to biology).
- 7. Though the experience gained by many evolutionary studies a **new conception of policy** intervention emerges. The experience can also be the background for—an enlightened type of—**predictive analysis**.



Andersen's thesis in the EE book as an overambitious research programme

- Andersen wanted to cover all aspects of viable new evolutionary economics that is characterised by
 - (1) a population perspective,
 - (2) an empirical orientation,
 - (3) a mix of an algorithmic and a fully formal approach, and
 - (4) a 'dialogue' with older, verbal studies of economic evolution



The Nelson-Winter model as a difficult starting point - I

- Andersen's failures in terms of Varian's advice
 - Looking for good ideas in in complex papers and models rather than in empirical regularities
 - Ignoring the basic structure of models in order quickly to replicate the Nelson-Winter work
 - Not starting by making model as simple as possible
 - Looking too much in the literature before own model was developed
 - Not designing clearcut and convincing seminar presentations but rather introducing too many complexities
 - Not having clear seminar outlines for paper production
 - Not stopping before things get too complex



The Nelson-Winter model as a difficult starting point - II

- Andersen's failures in terms of his advice for evolutionary modelling
 - Not spending enough time to think about the basic mechanisms of evolution before the modelling started
 - Not avoiding the complexity crisis because of the wish to replicate complex models
 - Setting up very general goals rather than clearcut tasks like the explanation of a clearcut stylised fact; don't be too general
 - Not working backwards from the concrete phenomema
 - Not recognising clearly what the basic questions are relevant in general models—like the avoidance of monopoly
 - Wanting too many things: general model building, computer simulation and mathematical analysis



The Nelson-Winter model as a difficult starting point - III

- Andersen's failures in terms of his advice for evolutionary simulation
 - Building on a complex rather than a simple simulation model
 - Not making a demand specification for your version
 - Not making a sufficiently detailed model design
 - Although lots of verbal descriptions, flow charts, pseudo-code, ...
 - Not developing the program step by step
 - Much too often the simulation program did not run correctly!
 - Not performing systematic simulation experiments
 - Not making deep statistical analysis
 - Not making a cumulative and extensive documentation



Overcoming the difficulties and failures

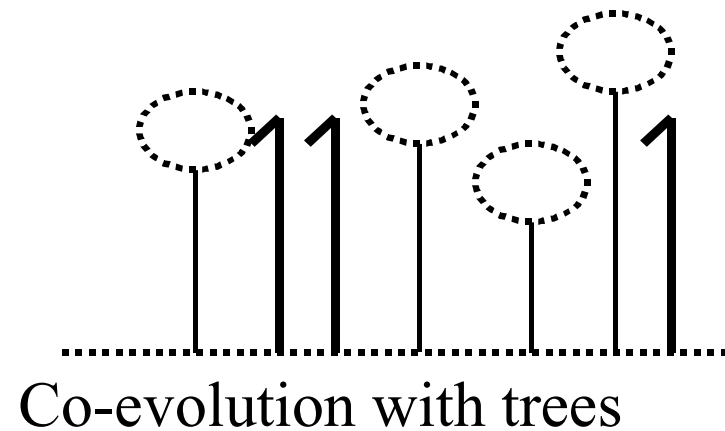
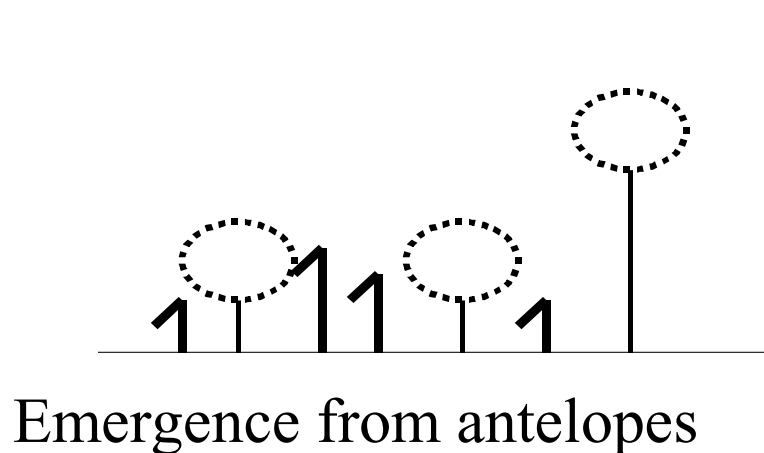
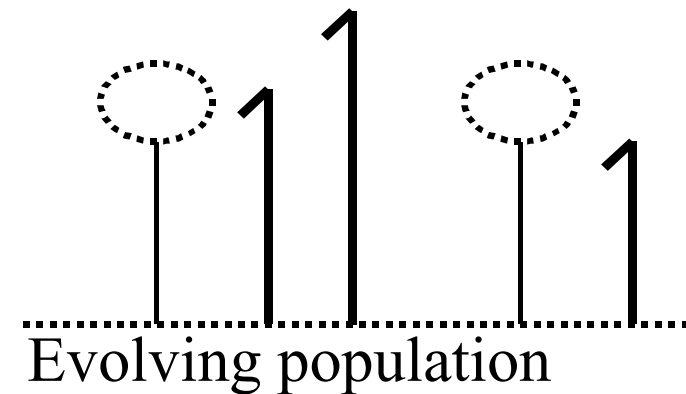
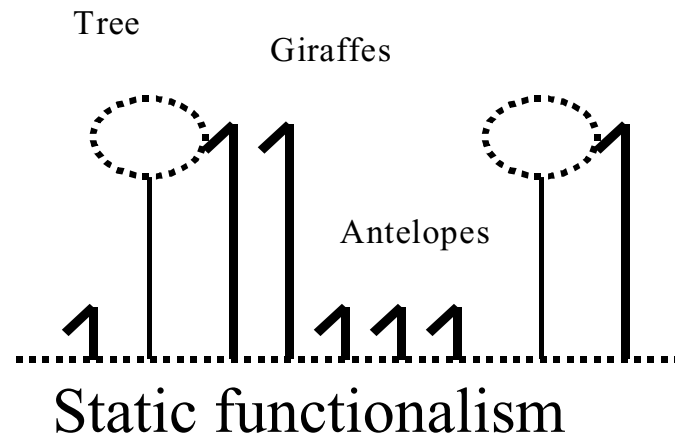
- Development of families of Nelson-Winter models and *AL* models that start from replicator dynamics
 - Complexity is introduced in a step-wise manner
- Development of concrete models to explain concrete phenomena
 - Like macroeconomic demand satiation and the stylised history of the software industry
- Use of the Lsd system for simulation models
 - Makes gradual model development and statistical analysis easy
 - Gives easy tools for model documentation and distribution
- Use Price's evometrics to understand the dynamics of simulations and to start exploration of empirical data



The role of analogies in the development of evolutionary economics

- Schumpeter disliked analogies
 - They are of the process of scientific discovery
 - Not part of the process of scientific justification
- Analogies to biological evolution have played an important role in the development of new evolutionary economics
 - Analogies are not equal to structural identity as in the case of Price's equation
 - But there are many examples of biological analogies

Biological analogies: Like explaining giraffes by function and selection





Analogy: biological explanations of giraffes

Why do giraffes have long necks?

1. **Functional explanation:** Helpful to reach tree leaves at the savannah
2. **Teleological explanation:** (Divinely) designed solution
3. **Lamarckist explanation:** Inheritance of characteristics acquired during the life of individual giraffes gives long necks
4. **Darwinian explanation:** Populations show hereditary differences. Individuals with longer necks produce more progeny than short-necked. The result is cumulative adaptation
5. **Neo-Darwinian-jump explanation:** New species by isolation among antelopes. One species adapts very quickly to the ecological niche of tree leaves. Later only small evolutionary change takes place
6. **Neo-Darwinian co-evolution:** (1) The grassing of rather long-necked giraffes favours higher savannah trees. (2) The increased height of trees favours longer-necked giraffes. Evolutionary race between (1) and (2)



Explaining behaviour of firms

Assume two forms of behaviour, A (best) and B (worse)

Why is A is persistently chosen by firms?

1. **Strong rational-choice explanation:** A is chosen because it is the globally best alternative and the agents are perfectly informed
2. **Functionalist explanation:** A is chosen because it is the globally optimal alternative. How it is chosen is not explained
3. **Reinforcement-evolutionary explanation:** Firms are unable to evaluate A and B without a process of trial-and-error. When a favourable behaviour is chosen, it is reinforced because of its revealed comparative advantage (profitability) for the firm. 'Simplistic Lamarckism'
4. **Natural-selection explanation:** Firms make inflexible choices between A and B. A-firms grow in the competitive struggle and B-firms go bankrupt. 'Simplistic Darwinism'
5. **Schumpeterian explanation:** The normal process of evolutionary adaptation is ultimately conservative. The process of evolution will come to a stasis end unless extraordinary innovators makes jumps



Organisational ecology for inflexible firms and Darwinian evolution

- Core contributions
 - Hanan and Freeman, *Organizational Ecology* (1989); Carroll and Hanan, *The Demography of Corporations and Industries* (1999)
- Firms tend to stick to the form they got early in their life
 - As soon as they get a complex internal division of labour, it is very difficult to change their basic design and purpose
 - Both their customers and their lenders want firms to be **accountable** and **reliable** in their behaviour
 - To be able to **reproduce** their products etc. very precisely, firms develop organisational routines, cultures, ...
 - Because of the firm's routines, they show a large amount of **inertia** in organisation and behaviour



Organisational ecology: entry and exit

- Analogy: Markets are like savannahs, firms like giraffes
- Because firms change little, entry and exit are their important life events
 - **Entry** means the creation of the firm
 - Entry is **difficult** since the firm immediately competes with established firms in the market
 - Therefore, firms are often created as **spin-offs** of other firms
 - The spin-offs **inherit** many characteristics of the mother firms
 - **Exit** is due to **closure and merger** of firms
- Collecting and analysing so-called vital statistics
 - Based on facts on e.g. the background of the entrepreneurs that create new firms and which of the firms that survive, we can test the theories on spin-offs, etc.



Organisational ecology: competition

- Markets as ecological niches for firms
 - The firms in a market niche is the **population**
 - If the number of firms in a market is constant, we may assume that this number is the **carrying capacity** of the market
 - The carrying capacity is influenced by **demand** for the product and competition/cooperation with **other industries** and broader issues of **legitimisation** of the industry
 - A new industry has a low **population density** relative to the carrying capacity. Therefore entry is larger than exit. Gradually it reaches the limit where entry = exit
 - Markets and their populations can split up into relatively independent submarkets and **subpopulations** (like giraffes and antelopes)



The Lamarckist evolutionary organisation theory of Nelson and Winter

- Firms are organised through a system of routines
 - Routines are **not skills** of individual employees
 - Routines are defined as firm-level **capabilities**, 'the skills of the organisation'
 - The upholding of routines rely on both **formal and tacit knowledge** of the employees
 - The firm has many routines, and they work together in a **routine system** that defines the functioning of the firm
 - An individual routine cannot easily be changed since other routines **depend** on it
 - The firm is also a social system that rely on a **ceasefire** between the conflicting parties through an **agreement**. This also complicates the changing of routines
 - **Intrapreneurship** is the overcoming of these difficulties



Caveats

- The evolutionary approach requires careful thinking
- The evolutionary approach is process oriented, and this makes it more complex than simple approaches
- Inertia may exist at different levels
 - If the firm as a whole has much inertia, then 'Darwinian selection'
 - If the plants or groups has much inertia, then internal selection
 - If groups have little inertia, then learning dominates (unclear evolution)
- The evolutionary approach is dynamic and population oriented
 - The limits of the population may change over time



Schumpeter's complexity crisis

- He wanted quickly to develop an overambitious theory of economic evolution
- He used Walras' general equilibrium system as a "springboard" for the development of this theory
 - Thus he imported a lot of complexity into his theory
- He made an implicit reinterpretation of the Walrasian system and never studied the changed details
 - Especially, he lacked an analysis of the selection processes
- He wanted to apply his theory directly to historical and statistical facts
 - Not following his own rule of the "incessant give and take between them".



Rethinking Schumpeter's five main roles

- Evolutionary economics as the primary task
- Neoclassical economics as covering a very special case
- Economic history as the basic source of explananda
 - Economic evolution is a unique process in historical time
- Economic sociology as a core complement
 - Evolutionary history is also a sociological phenomenon
- Methodology and history of evolutionary economics as an important field
 - Because of the strangeness of evolutionary processes when evaluated in terms of standard scientific procedures



Rethinking the Battle of Methods - I

Historists (Germany)	Neoclassicists (Austria)
Historically rooted theory	Timeless theory
Induction	Deduction
Facts	Speculation
Nationalistic	Cosmopolitic
Protection	Liberalism
Intervention, conservative reform, Kathedersozialismus, Verein für Sozialpolitik	Laissez-faire
“Organic”, “collectivistic”	“Atomistic”, individualistic
Sociologically oriented	Non-sociological, “economic man”



Rethinking the Battle of Methods - II

		Stationary phenomena	“Evolutionary” phenomena	
			Simple	Mutative
Static analysis		(1)	(2)	(3)
	Dynamics Analytic	(4)	(5)	(6)
	Historic	(7)	(8)	(9)

Based on *History of Economic Analysis*.

Neoclassicism starts from (1) while evolutionary studies starts from (9). The task is to fill out the rest!



Rethinking the Battle of Methods - III

- In terms of an instrumentalist methodology
 - Both historical and theoretical methods are necessary
 - We need a specialisation like between theoretical physics and experimental physics
- In terms of the Schumpeterian sociology of science
 - The battle is mainly explainable in sociological terms
 - Scientists tend to organise in competing Schools
 - This is very problematic for the further evolution of science
 - The battle was largely overcome by specialisation
 - Between economics and sociology, and within economics
 - The battle may relate to more basic paradigm conflicts
 - Normal science opposes paradigm shift toward evolution
 - Evolutionary economics/sociology open a new agenda



Next sessions

- Session 1: Introduction
- A. Post-Schumpeterian evolutionary modelling
 - Sessions 2-5
- B. Schumpeter's theories in retrospect
 - Sessions 6-9
- **C. Research horizons**
 - **Session 10: Andersen's contribution**
 - **Andersen's EE book, ch. 6 + several papers**
 - **Session 11: Students' contributions**
 - **5 minutes presentations + short discussions**